THE COLLECTION OF BITING FLIES IN WEST TEXAS WITH MALAISE AND ANIMAL-BAITED TRAPS[1]

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In a study of the associations between hematophagous Diptera and mammals on some of the livestock ranges of West Texas, two types of insect traps, Malaise and animal-baited, were compared in three localities. The field collections were a cooperative activity of Texas A&M University and the U. S. Department of Agriculture, and were made while the senior author was a temporary employee of the U.S.D.A. Livestock Insects Laboratory at Kerrville, Texas.

The Malaise trap is named for its original developer, René Malaise (1937), and consists of a light wooden frame covered with a fine-mesh netting. When an insect's flight is interrupted by the netting, it moves upward in an attempt to escape, passes through the funnel-like collecting apparatus, and enters a killing jar at the top of the trap.

Breeland and Pickard (1965) reported that a Malaise trap was used in Tennessee in connection with an arthropod survey and that it had several advantages over light traps and other devices for the collection of adult mosquitoes. Two of the same workers (Smith *et al.*, 1965) later reported that large numbers of muscoid flies, tachinids, tabanids, blowflies, flesh flies, and bees and wasps were collected as well as mosquitoes, but that the Malaise collections included significant numbers of medically important species. They recommended the use of Malaise traps in surveys of hematophagous Diptera.

Since animal-baited traps have also been used very successfully for collecting blood-sucking Diptera, it was decided to compare Malaise and animal-baited traps under the semi-arid conditions found on livestock ranges in West Texas. The animal-baited trap used in this study was adapted from a design used by Bellamy and Reeves (1952).

METHODS AND MATERIALS. Plans prepared by Townes (1962) were used for the construction of the tent-like Malaise trap used in this study except that the framework was constructed of aluminum rather than softwood, and vinyl plastic was used to build the collecting apparatus instead of cellulose acetate.

The animal-baited traps were made from 110-lb.-capacity lard cans with saran-covered cones inserted in both ends. A mason jar was soldered over a 2-in.-diameter opening in the side of the can. A vinyl plastic cone was then cemented inside the jar lid flush with the inside of the can so that the smaller end of the cone was pointing into the mason jar when the jar was screwed into the lid.

Six-in.-diameter cylinders 15 in. long, fashioned from chicken wire, were used to confine California jackrabbits (*Lepus californicus*) and Audubon's cottontail rabbits (*Sylvilagus auduboni*). A rectangular box trap 15 in. long and constructed of ¼-in. hardware cloth was used to restrain smaller mammals.

A Malaise and animal-baited trap were placed in each trapping location but separated by 30 ft. or more. The animal-baited trap was shaded to protect the animal from the intense heat of the sun and was suspended 4–5 ft. above the ground from a tree limb; it was not placed any higher because the trees were relatively low growing. No insects were collected in preliminary tests with animal-baited traps placed on the ground. All traps were

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placed near a running stream, a stock tank, or some other water source.

The animal-baited traps were covered with black muslin, except the mason jar in the side, and in most instances the dipterous insects were attracted to the light, entered the jar, and could be removed with a minimum amount of handling during daylight hours. In periods of darkness artificial light failed to attract the insects into the jar; consequently they were removed from the trap only during daylight hours.

During the summer of 1966 five Malaise and five animal-baited traps were operated in suitable locations in the Brackettville area for a 17-day period, moved to Marfa and operated for a 20-day period, and then were operated for 13 days in the vicinity of Presidio. The contents of the 10 traps were removed twice daily but because of travel distances involved it was not possible to remove the insects from all traps at dawn and dusk; consequently, it was not possible to ascertain the nocturnal and diurnal activities of all species with any degree of certainty.

DISCUSSION. As shown in Tables 1–3, only mosquitoes were collected in both the animal-baited and Malaise traps. All other species were collected in the Malaise trap only.

MOSQUITOES. Four genera of mosquitoes, *Culex, Psorophora, Aedes,* and *Anopheles,* were collected in the three trapping areas. The genus *Culex* constituted more than 56.23 percent of the total mosquito collection. These included 177 specimens of *C.*

TABLE 1.—Biting flies collected from the Malaise and animal-baited traps in the Brackettville, Texas area.

Date	Malaise		Animal baited		
Week ending July 9			Guinea pig		
Tabanus abactor	25		..		
Tabanus subsimilis	3	1*	..		
Forcipomyia sp.	87		..		
Phlebotomus diabolicus	30	18*	..		
Phlebotomus texanus	1		..		
Psorophora confinnis	1		..		
Aedes trivittatus	1		..		
Culex erraticus	8		1		
Week ending July 16			*Neotoma micropus***		*Perognathus hispidus****
Tabanus abactor	42		..	..	..
Chrysops flavidus	10		..	..	..
Phlebotomus diabolicus	28	19*	..	..	..
Phlebotomus texanus	2		..	..	..
Phlebotomus anthophorus	1		..	..	..
Culex erraticus	6		13	..	4
Culex quinquefasciatus	2		5	..	..
Culex tarsalis	..		2	..	..
Anopheles p. pseudopunctipennis	3	1*	..	..	..
Week ending July 23					
Tabanus abactor	8		..	..	..
Tabanus subsimilis	1		..	..	..
Phlebotomus diabolicus	2		..	..	..
Chrysops flavidus	1		..	..	..
Culex tarsalis	..		3	..	..
Culex erraticus	1		97	..	39
Culex quinquefasciatus	..		9	..	..
Anopheles p. pseudopunctipennis	3		..	..	..

* Male flies; all other numbers indicate female flies.
** Grey wood rat.
*** Hispid pocket mouse.

erraticus, 65 *C. tarsalis*, 34 *C. thriambus*, 18 *C. quinquefasciatus*, and 17 *C. coronator*. One hundred and thirty-six specimens of *C. erraticus* (76.8 percent) were collected in an animal-baited trap during the week ending July 23 in the Brackettville area. *C. tarsalis* was the second most numerous species of *Culex* collected and was fairly evenly distributed in all trapping areas and throughout the collecting period. Over 75 percent of this species was taken in an animal-baited trap. *C. thriambus* was collected only in the Marfa area and 61.76 percent was taken in a Malaise trap. All but one specimen of *C. quinquefasciatus* were taken in animal-baited traps in the Brackettville area during the weeks ending July 16 and 23. Eleven of 17 specimens of *C. coronator* collected in the Marfa and Presidio areas were taken in Malaise traps.

TABLE 2.—Biting flies collected from the Malaise and animal-baited traps in the Marfa, Texas area.

Date	Malaise	Animal-baited		
		N. micropus	*Lepus californicus***	*Dipodomys spectabilus****
Week ending July 30				
Culicoides variipennis	8	..	..	..
Culicoides haueri	1	..	..	..
Tabanus subsimilis	4	..	..	..
Tabanus punctifer	1*	..	..	..
Culex tarsalis	7	..	2	2
Culex thriambus	8	1	..	5
Culex erraticus	4	..	..	..
Culex coronator	4	..	..	..
Aedes vexans	68	..	..	..
Aedes trivittatus	3	..	12	..
Psorophora confinnis	62	..	1	..
Anopheles p. pseudopunctipennis	2	..	..	..
Week ending August 6				
Culicoides variipennis	1	..	..	..
Forcipomyia sp.	2	..	..	..
Phlebotomus californicus	1	..	..	..
Phlebotomus vexator	5 3*	..	..	..
Phlebotomus oppidanus	1*	..	..	..
Phlebotomus anthophorus	1	..	..	..
Tabanus subsimilis	1	..	..	..
Aedes vexans	23	..	..	..
Aedes trivittatus	3	..	24	4
Culex tarsalis	3	..	1	7
Culex thriambus	4	..	..	2
Culex coronator	4	..	1	..
Culex erraticus	1	..	..	..
Psorophora confinnis	1	..	..	..
		*Sylvilagus audubon*i*****	*Citellus spilosoma* ******	
Week ending August 13				
Atrichopogon sp.	1	..	..	..
Culicoides variipennis	1	..	..	..
Forcipomyia sp.	2	..	..	..
Aedes trivittatus	3	6	1	2
Aedes vexans	2	..	..	..
Culex tarsalis	4	..	..	2
Culex thriambus	9	..	..	5

* Male flies.
** California jackrabbit.
*** Banner-tailed kangaroo rat.
**** Audubon's cottontail.
***** Spotted ground squirrel.

TABLE 3.—Biting flies collected from the Malaise and animal-baited traps in the Presidio, Texas area.

Date	Malaise		Animal-baited			
Week ending August 20			*C. spilosoma*	*D. spectabilus*	*S. auduboni*	*D. merrami***
Chrysops pachycerus hungerfordi	5		..	..	..	..
Tabanus subsimilis	1		..	..	..	..
Culex tarsalis	2		..	3	..	..
Culex coronator	2		..	..	..	..
Culex erraticus	..		..	..	..	1
Aedes vexans	4		..	..	..	..
Aedes sollicitans	2		..	..	..	..
Psorophora confinnis	6		..	..	..	..
Psorophora cyanescens	2		..	..	..	..
Phlebotomus oppidanus	2		..	..	..	..
Week ending August 27						
Chrysops pachycerus hungerfordi	5	1*	..	..	..	..
Culex coronator	1		1	..	1	..
Culex tarsalis	..		1	1	..	..
Culex erraticus	..		..	..	2	..
Aedes vexans	..		..	..	1	..
Aedes sollicitans	1		..	..	..	..
Atrichopogon sp.	1		..	..	..	..

* Male flies; all other numbers indicate female flies.
** Merriam's kangaroo rat.

The genus *Aedes* ranked second to *Culex* in number of specimens collected. Of three species, *vexans* constituted 61.24 percent of all *Aedes* and all but one specimen were taken in the Malaise traps. No members of this species were taken in the Brackettville area.

Aedes trivittatus constituted 37 percent of the *Aedes* collected. Eighty-three percent were collected in animal-baited traps and all but one of 59 specimens were taken in the Marfa area.

Three specimens of *Aedes sollicitans* were collected in Malaise traps in the Presidio area.

Two species of *Psorophora, P. confinnis* and *P. cyanescens*, were collected. Seventy of 71 specimens of *P. confinnis* were taken in Malaise traps and 89 percent were collected in the Marfa area during the week ending July 30. Only two specimens of *P. cyanescens* were collected and both were taken in Malaise traps in the Presidio area.

Only nine specimens of *Anopheles, A. pseudopunctipennis pseudopunctipennis*, were collected, and all were taken in Malaise traps. Seven were collected in the Brackettville area and two in the Marfa area.

CERATOPOGONIDAE. As indicated in Tables 1 and 2, 87 specimens of *Forcipomyia* spp. were collected in the Brackettville area during the week ending July 9. Four additional specimens were collected in the Marfa area, two during the week ending August 6 and two during the week ending August 13. It is unlikely that members of this genus would be collected in an animal-baited trap because, according to Wirth,[4] none of the species are known to ingest vertebrate blood. Specific identification of the members of this poorly known genus has not been completed. Single specimens of an undetermined species of *Atrichopogon* were collected in a Malaise trap near Marfa on August 9 and near Presidio on August 23.

[4] Wirth, W. W., Entomologist, Insect Identification and Parasite Introduction Branch, Entomology Research Division, U. S. Dept. of Agriculture, Washington, D.C. Personal communication, 1966.

In spite of generally favorable weather conditions, no *Culicoides* gnats were trapped at Brackettville or Presidio; the only specimens, 10 of *C. variipennis* and one of *C. baueri,* were obtained in Malaise traps near Marfa.

Phlebotomus. Six species of this genus were collected in Malaise traps and one or more species were found in each of the three localities. At Brackettville, *P. diabolicus* predominated but *P. texanus* and *P. anthophorus* were also found. Of the four species trapped at Marfa or Presidio, the collections of *P. californicus* and *oppidanus* represent new state records for Texas (Easton *et al.,* 1967).

TABANIDAE. Our study, like that of other workers, indicated that the Malaise trap is very useful for collecting horse flies and deer flies. At Brackettville, *Tabanus abactor* was the most abundant species, but it was not trapped in the other two areas. *T. subsimilis* was the only species collected at all three locations. *Chrysops flavidus* was found only at Brackettville, *T. punctifer* only at Marfa, and *C. pachycerus hungerfordi* only at Presidio.

Mosquito engorgement occurred in all instances in which a jackrabbit was used in animal-baited traps (*Aedes trivittatus* females were all engorged), but no engorgement was noted with the smaller rat-sized mammals. This difference may have been associated with the mesh size of the holding container; not only may the ¼-in. mesh have provided more of a barrier to mosquito movement, but the movement of the test animals in these traps may have inhibited the feeding activity of the mosquitoes. The larger lagomorphs were tightly confined so as to restrict movement and provide the blood-sucking mosquito with an accessible body surface.

The collections may indicate a preference of the insects for large animals over rodents and lagomorphs.

When the efficiency of the Malaise trap is compared with that of the animal-baited trap, it is possible that the number of species attracted to a particular host animal in the animal-baited trap will be much lower than the number collected in the Malaise trap. With the possible exception of some mosquitoes, such as *C. erraticus,* the Malaise trap seems to be more useful as a general survey tool for hematophagous Diptera.

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